Fabrication of soft x-ray beam splitters
for use in the wavelength of region around 13 nm

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We advance to develop beam splitters for interferometric, polarization, and lazing experiments in the soft x-ray region. We fabricated two types of the soft x-ray beam splitter, one is a Mo/Si multilayer type and the other is a Ru/SiN bilayer type, for use at around a wavelength of 13 nm.

In the case of grazing incidence angle, the total reflection of a single-layer is useful. But beyond the critical angle, the x-ray reflectivity is very low. The Bragg reflection of a multilayer can enhance the reflectivity beyond this angle. From this viewpoint, we designed the Ru/SiN bilayer beam splitter using the total reflection of Ru single-layer for an incident angle of 20 degree and the Mo/Si multilayer beam splitter using the Bragg reflection for around normal incident angle. The Ru single-layer has the thickness of 2.5 nm. The Mo/Si multilayer has the periodic length of 6.86 nm and the number of layer pairs of 16.

To fabricate the beam splitters, we deposited the Mo/Si multilayer or the Ru single-layer on SiN membranes by sputtering. After these depositing, the SiN membranes were removed by reactive ion etching. In the case of Ru beam splitters, the thickness of SiN membrane was left about 60 nm, to support very thin Ru single-layer. Figure 1 shows the picture of our fabricated beam splitter. The window size of this beam splitter is 10 mm square.

Figure 1: Measured reflectivity (solid line) and transmittance (dotted line) of Mo/Si multilayer beam splitter at an incident angle of 80° (left) and Ru/SiN bilayer beam splitter at a wavelength of 13 nm (right).